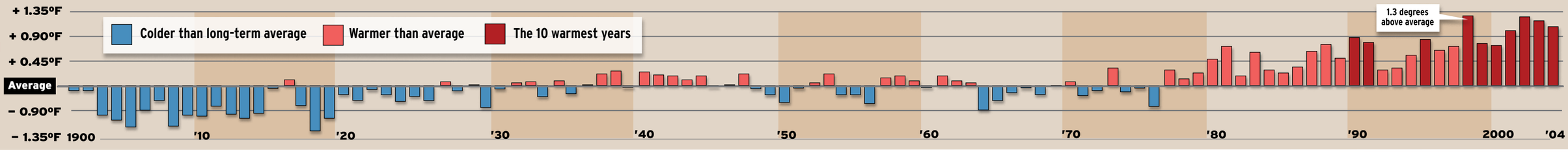
Hottest years on record

Since 1900, the world's warmest recorded years have all come in the last 25 years.



WARMING TO THE THREAT

EVIDENCE POINTS TOWARD A TROUBLING SHIFT IN EARTH'S CLIMATIC BALANCE

Are we guilty of tipping the balance? A look at the evidence.

Consensus among scientists is that, yes, global warming is here. The Earth's average surface temperature is rising higher and faster than at any time in the past 1,000 years. The cause? It's complicated. Based on the available evidence, here's what we know:

- **More than likely**, human activity is contributing to this rise.
- **When plugging earlier data**, plus rising CO_2 data, into climate models, the results come close to simulating current climatic conditions.
- **Earth's surface temperature** has already risen, but models are predicting an average increase of between 2.7 and 10.44 degrees by the year 2100.
- **Models that predicted** global warming would occur all assumed air temperatures would rise in the troposphere – the lower atmosphere – and near the planet's surface, which has actually occurred.

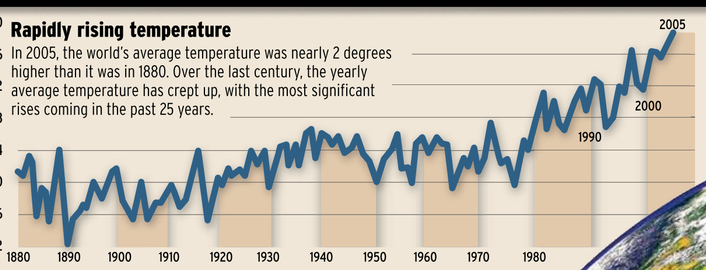
THE EVIDENCE is laid out in a series of exhibits (shown right). For an expanded examination of global warming, please go to **www.sltrib.com** and follow the links.

Reported by Greg Lavine, graphic by Todd Adams
The Salt Lake Tribune

EXHIBIT A: Feeling the heat

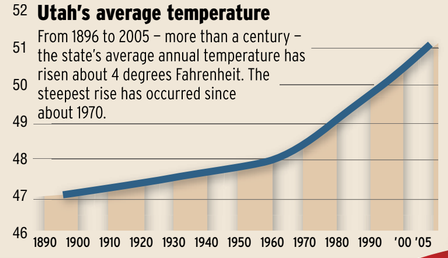
Rapidly rising temperature

In 2005, the world's average temperature was nearly 2 degrees higher than it was in 1880. Over the last century, the yearly average temperature has crept up, with the most significant rises coming in the past 25 years.



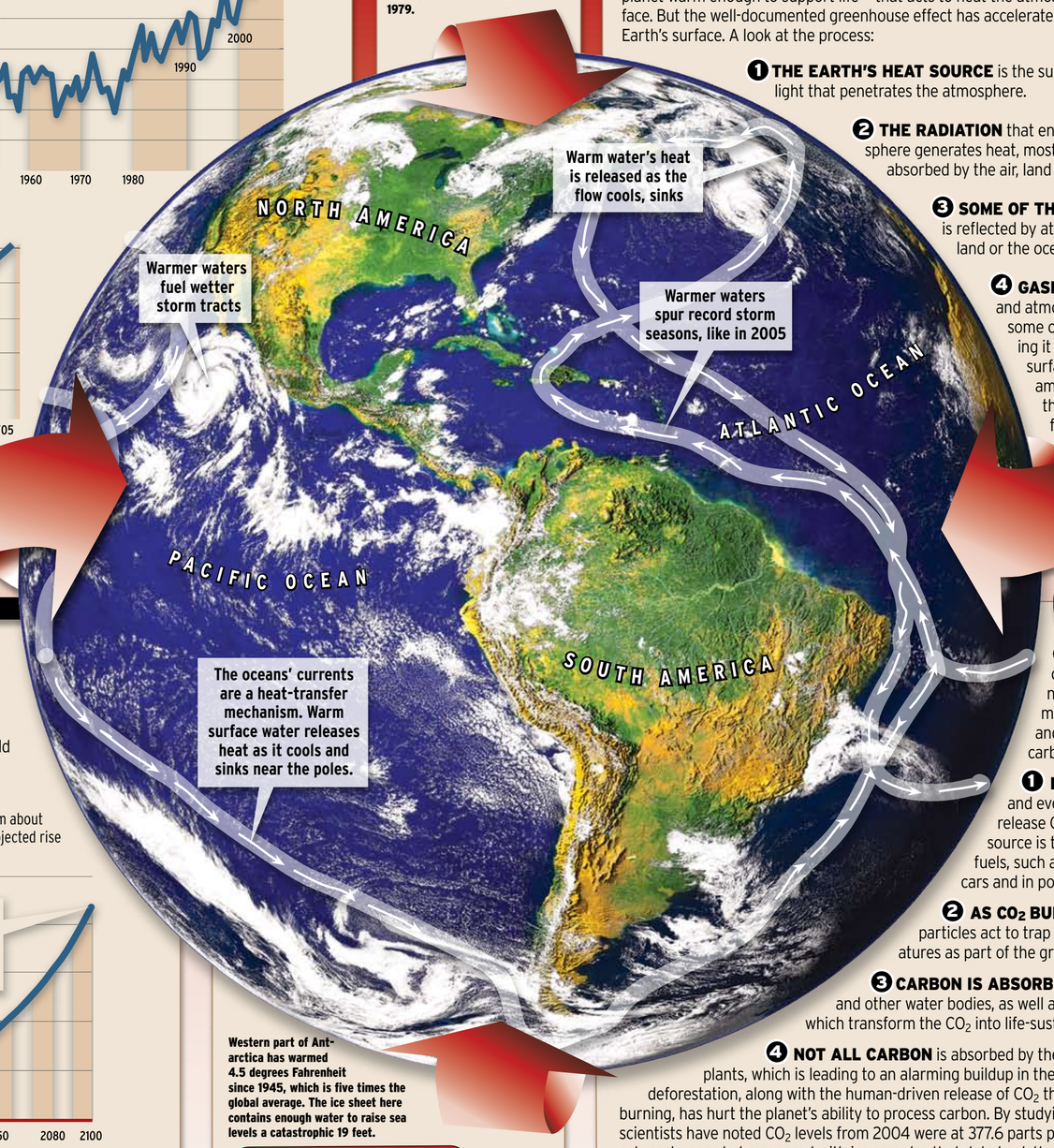
Utah's average temperature

From 1896 to 2005 – more than a century – the state's average annual temperature has risen about 4 degrees Fahrenheit. The steepest rise has occurred since about 1970.



Flashpoint: Arctic

Floating ice cap shrank to a record-low mass of 2.2 million square miles in 2005 – its lowest mark since 1979.



The Intergovernmental Panel on Climate Change projects thermal expansion (warming of oceans) to continue, raising sea levels and affecting weather patterns.

Flashpoint: Pacific Ocean

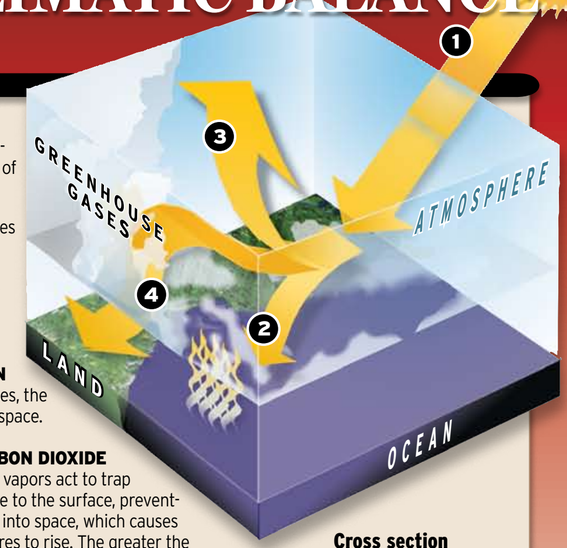
Western part of Antarctica has warmed 4.5 degrees Fahrenheit since 1945, which is five times the global average. The ice sheet here contains enough water to raise sea levels a catastrophic 19 feet.

Flashpoint: Antarctica

EXHIBIT B: Earth's greenhouse

THE EARTH HAS ITS OWN natural greenhouse effect – which keeps the planet warm enough to support life – that acts to heat the atmosphere and surface. But the well-documented greenhouse effect has accelerated the warming of Earth's surface. A look at the process:

1. **THE EARTH'S HEAT SOURCE** is the sun, which radiates light that penetrates the atmosphere.
2. **THE RADIATION** that enters the atmosphere generates heat, most of which is absorbed by the air, land and water.
3. **SOME OF THE RADIATION** is reflected by atmospheric gases, the land or the oceans back into space.
4. **GASES LIKE CARBON DIOXIDE** and atmospheric water vapors act to trap some of the heat close to the surface, preventing it from escaping into space, which causes surface temperatures to rise. The greater the amount of gas and water vapor in the atmosphere, the greater the amount of radiation that is trapped, further warming the surface.



Cross section showing Earth's greenhouse effect

Flashpoint: Atlantic Ocean

The most convincing evidence of ocean warming is in the Atlantic Ocean, where 73 years of data near Bermuda show an almost constant rate of interior warming.

EXHIBIT C: Carbon counting

CARBON AND ITS GASEOUS cousin carbon dioxide occur naturally, and the Earth has a mechanism – namely plants and the oceans – to recycle carbon.

1. **PLANTS, ANIMALS** and even the oceans release CO_2, but another source is the burning of fossil fuels, such as gas and coal, in cars and in power plants.
2. **AS CO_2 BUILDS**, atmospheric particles act to trap heat, raising temperatures as part of the greenhouse effect.
3. **CARBON IS ABSORBED** into the oceans, and other water bodies, as well as plants and trees, which transform the CO_2 into life-sustaining oxygen.
4. **NOT ALL CARBON** is absorbed by the land, water and plants, which is leading to an alarming buildup in the atmosphere. Rapid deforestation, along with the human-driven release of CO_2 through fossil-fuel burning, has hurt the planet's ability to process carbon. By studying ice from glaciers, scientists have noted CO_2 levels from 2004 were at 377.6 parts per million – the highest mark recorded compared with ice samples that date back thousands of years.

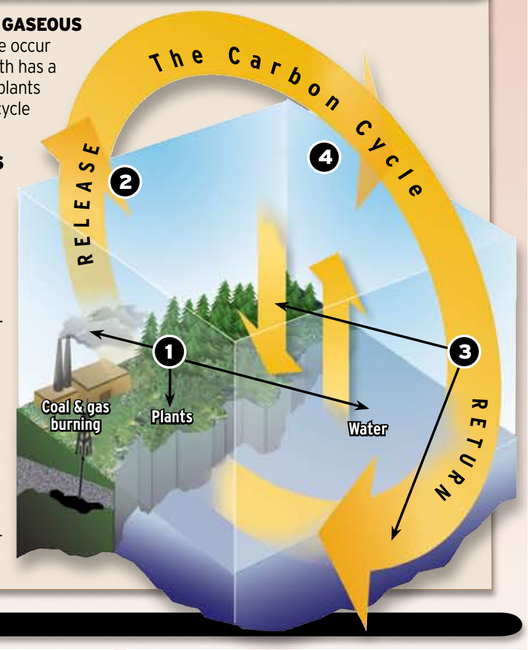
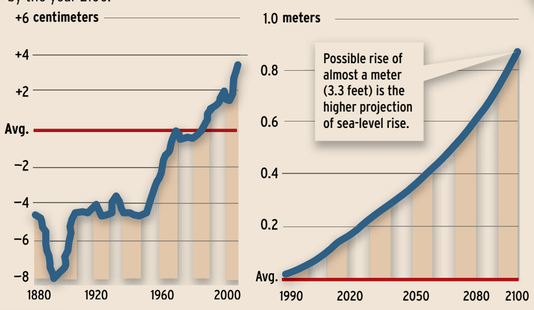


EXHIBIT D: Troubled waters

CATASTROPHE IN THE MAKING? The rise in the world's sea levels is well-documented, but the complexity of climate and its effect on the world's bodies of water are not fully understood. Even so, sea levels are expected to rise further; the most catastrophic projections show a rise of more than 3 feet by 2100 – an increase that would threaten many lowlands.

Rising sea levels

The mean sea level has risen almost 12 centimeters (4.7 inches) from about 1890 to 1980. Below left is the five-year mean. Below right is the projected rise by the year 2100.



Sources: United Nations' Intergovernmental Panel on Climate Change, World Meteorological Society, National Aeronautics and Space Administration, wire reports

SYMPTOMS: A visual reference

Glaciers recede: From Greenland to the Andes Mountains of Peru, glaciers are melting at a rapid rate.

Sea life graveyard: Crabs and sea stars are dying and washing ashore on the Pacific Northwest coast.

Air pollution: Carbon dioxide readings from air-monitoring equipment show a rapid increase worldwide.

Artic breakup: Ice floes in the Arctic are receding at a rate that is unprecedented in modern times.

Extreme events: Flooding and severe weather such as Hurricane Katrina grow more common.

Uncommon data: In the film "An Inconvenient Truth," the climatic anomalies are seen as the new norm.

Higher ground: From China, above, to Bangladesh, coastal residents are increasingly threatened by high water.